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NIF Target Alignment Using a 351 nm Laser Source, and Chamber Center Reference System, and a Target Alignment Sensor

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Abstract

The operational requirements of the National Ignition Facility (NIF) place tight constraints upon its alignment system. All 192 beam lines must be accurately, precisely, and promptly aligned onto targets. In order for alignment of all the different parts of the laser chain to be completed within the allotted time, automated and decoupled procedures must be implemented. By introducing an alignment source, directed towards the Target Chamber, in the Transport Spatial Filter, the need to wait for amplifier cool down prior to pulse-onto-target alignment is eliminated. Individual pulses must be pointed onto targets with accuracy greater than 6 microns. This pointing is controlled by the final steering mirror. In order for the alignment beam to follow the shot time pulse path to chamber center, it must be pointed into the final steering mirror parallel to the pulse path. This can be arranged by introducing 351 nm light at the intersection of the one micron pulse path with the 351 nm focal plane of the final lens of the Transport Spatial Filter.

The alignment beam propagates through the transport system and the final optics assembly into the Target Alignment Sensor (TAS). The TAS is a device which allows the simultaneous viewing of a target and alignment beams as they would appear were they to impinge upon that target. The orientation and location of the TAS is measured by the Chamber Center Reference System (CCRS). The CCRS consists of two optical systems that view Target Chamber Center (TCC) from orthogonal ports. The CCRS operates in two modes. In the first, the orientation (rotation) of the TAS at TCC is measured by autocollimation off of a TAS mounted reflector assembly, and nulled by the motorized TAS positioner. In the second, the reflector surface, a portion of which is unsilvered, is imaged with the same lens that was used in autocollimation. The shape of the unsilvered region is projected onto a coordinate map via the 1:1 relay. Thus each arm of the CCRS measures two rotations and two displacements.

We describe the target alignment system set forth in the NIF Title I design, detailing insertion of the 351 nm alignment beam, measurement of the TAS location and orientation, and insertion of targets into the TAS and the pointing of alignment beams onto the target.

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